

Ethnic Student Organizations in Engineering: Implications for Practice from Two Studies

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Abstract

In this paper, we present results and implications from two studies focusing on the participation of African American and Latina/o students in ethnic student organizations. Conducted independently by two research teams, the two studies provide striking similarities in their findings. The combined body of work provides unambiguous evidence for the common assumption that participation in ethnic student organizations at predominantly White institutions bolsters underrepresented students' engineering identity development, persistence, and success in engineering studies and subsequent careers. Findings related to African American student and alumni participation in the National Society of Black Engineers (NSBE) mirror several findings from the study of Latina/o students in the Society of Hispanic Professional Engineers (SHPE). Specifically, results from the two studies share three common themes. Participants describe NSBE and SHPE as 1) providing opportunities for or explicitly emphasizing the development of professional and leadership skills; 2) having access to an engineering role model or becoming a role model themselves; and 3) creating a family-like support system. This paper focuses on the implications for institutional policies and college-level professionals derived from our combined body of work. We advocate for faculty, staff, and administrators to recognize the value of student participation in NSBE and SHPE and actively support student participation in these organizations. Furthermore, we suggest methods and pathways by which these key institutional players may support students; most important of which is through creating academic and social counter-spaces on their campuses. Doing so may ultimately enhance recruitment, transition to college, and persistence in engineering for students of color.

Background

Ethnic student organizations serve as necessary subcultures, especially in predominantly White institutions (PWIs), for the cultural integrity and adjustment^[1], and social integration^[2] of undergraduate students of color. Research has shown that cultural enclaves, such as ethnic student organizations, aid students of color in navigating unfriendly campus environments^[3]. While support for ethnic student organizations is often mentioned in the engineering education literature, the influence of ethnic student organizations upon students' engineering journeys has been understudied.

Founded in Los Angeles in 1974, the Society of Hispanic Professional Engineers (SHPE) is one of the largest Hispanic engineering organizations in the United States. Today, SHPE's mission focuses on changing "lives by empowering the Hispanic community to realize its fullest potential and to impact the world through STEM awareness, access, support and development," SHPE has

chapters nationwide, including Hawaii, Puerto Rico, and Alaska ^[4]. In fact, students and professionals can be part of SHPE chapters at the high school level, university level, and professional level.

The National Society of Black Engineers (NSBE) is a 501(c)(3) nonprofit organization that is owned and managed by its members. With more than 31,000 members, NSBE is one of the largest student-governed organizations in the country. Founded in 1975, NSBE now includes more than 394 College, Pre-College, and Technical Professional/Alumni chapters in the United States and abroad. NSBE's mission is "to increase the number of culturally responsible Black engineers who excel academically, succeed professionally and positively impact the community." The organization is dedicated to the academic and professional success of African-American engineering students and professionals. NSBE offers its members leadership training, professional development activities, mentoring opportunities, career placement services and more. The Society is governed by an executive board of college students and engineering professionals and is operated by a professional staff at its World Headquarters, located in Alexandria, VA.

Introduction: *“Two Studies, One Message”*

In this paper, we present results and implications from two independent studies focused on the participation of African American and Latina/o students in ethnic student professional organizations. Subsequent to a discussion at the 2015 ASEE National Conference, we discovered that both of our studies provide striking similarities in their findings despite having been conducted without any knowledge of each other's engagement with similar work. We contend that our mutual findings are of great significance to the engineering education community.

The author of one study (Renata) utilized a mixed methods approach to explore how SHPE membership influenced the engineering identity development of Latina/o students. Previous studies show that students who build engineering identities in their college career are more likely to persist within their engineering programs, thus illustrating the importance of engineering identity development to persistence. However, previous studies of engineering identity development have focused on a general type of engineering student, which may not capture the experiences of students of color. As a result, Renata's study purposefully used Yosso's Community Cultural Wealth framework, conceptualized from Critical Race Theory, to focus on how Latina/o students develop their engineering identity.

The authors of the other study (Julie, Shannon, Stacey, and Stephanie) employed a qualitative grounded theory approach to explore how African American engineering students developed and practiced engineering-related skills through participation in NSBE. By examining how these students attribute their development of the traits identified in National Academy of Engineering's

report *The Engineer of 2020: Visions of Engineering in the New Century*^[5], they confirmed that NSBE, along with other ethnic student organizations for African American students, provided much-needed cultural enclaves on PWI campuses.

Both research teams then came together to compare findings. Shannon joined the project after the grounded theory data analysis was already underway. As a result, she was able to view the findings of both investigations from a new perspective with more clarity than the authors who had been engaged with data analysis for a long time. She leveraged this perspective to help synthesize the findings of both studies, pinpointing and articulating commonalities and distinct differences in the results. Shannon produced the majority of the writing of the text based on discussions between the two research teams

We noted three common themes that appear in both studies. Participants described NSBE and SHPE as (1) providing opportunities for or explicitly emphasizing the development of professional and leadership skills, (2) being or having access to an engineering role model, and (3) creating a family-like support system. Our combined body of work provides unambiguous evidence for the common assumption that participation in ethnic student organizations at predominantly White institutions bolsters underrepresented students' engineering identity development, persistence and success in engineering studies, and in subsequent careers.

We acknowledge that as interpretive researchers, we are also instruments^[6] in the research process. In an effort to ensure transparency, we outline in the sections below our collective and individual role and stance of the research process, along with our individual backgrounds, insights and “conceptual baggage”^[7] related to this research.

Research Team's Positionality Statement

As we endeavor to change the culture of engineering education to be more inclusive to students from all backgrounds, we simultaneously acknowledge that society in general—and specifically the current engineering education system—is raced, gendered, and classed. That is, engineering education was historically designed by and for middle to upper-class white men^[8, 9], which unfortunately is a history that continues to dominate the engineering curriculum and culture^[9-11]. Here, we challenge the status quo of this longstanding and implicitly exclusionary tradition. Furthermore, we reject the deficit perspective from which the majority of research involving the educational experiences of students of color is conducted^[12]. Unlike traditional models that are devised from a “fixing the student” perspective, we contend that students of color bring to their engineering education unique perspectives, knowledge, and cultural wealth from which the field of engineering can greatly benefit^[13]. We acknowledge that the climate on PWI campuses is often unwelcoming climate for students of color^[14, 15], and racial microaggressions are commonplace^[14, 15]. As a result, American and Latina/o students engineering students at these

institutions often experience feelings of exclusion from in the dominant campus culture. Such feelings are often magnified when overlaid with the raced, gendered, and classed culture of engineering.

Our work views ethnic student organizations as a means for students of color to maintain their cultural identity. Specifically, we elucidate how students use ethnic student engineering societies to navigate the dominant cultural norms of engineering and engineering education and the engineering profession. Simultaneously, ethnic student organizations have the potential to empower students of color to develop resistant capital^[13, 16] and challenge the existing educational culture to be more inclusive of students with varying backgrounds and life experiences.

We end our paper with a “call to action” to the entirety of the engineering education community to truly embrace diversity, seek to be more inclusive, and embrace the research that suggests and supports the need for ethnic student organizations.

Methods

SHPE Study

The second author, Renata, utilized a mixed methods approach to explore the influence of membership in the Society of Hispanic Professional Engineers (SHPE) on the engineering identity development of Latina/o students. The goal for using mixed methods approach was to develop a culturally relevant survey of engineering identity development. She used the findings from the qualitative phase of the study, obtained via interviews and observation methods, to inform the development of an engineering identity survey^[17]. She then administered a pilot survey created from this data to assess construct validity and reliability. In both phases, Renata used Yosso’s Community Cultural Wealth (CCW) framework^[13] to guide the study.

Renata collected twenty semi-structured interviews, which comprised the main data collection in the qualitative phase of the study exploring the influences of SHPE on Latina/o students. She used purposeful sampling to achieve intensity and variation in the data^[18], identifying information-rich participants from those who attended SHPE’s 2013 national conference. She conducted interviews, which were an average of fifty minutes in length, using videoconferencing capabilities such as Skype. While these interviews were the primary means of data collection, Renata also used participant observations to triangulate findings. She attended SHPE’s 2014 national conference and other events held by a local SHPE chapter as a participant observer. In both locations, she observed events and spaces that were salient for interview participants. Renata used two cycles of coding guided by Saldaña^[19] and by the CCW framework when analyzing the interview and observation data. She also used emergent coding, followed by thematic analysis in order to perform construct identification^[20] toward survey development.

Renata then used results from the qualitative phase of the study to develop an engineering identity survey. She used the themes derived from the qualitative phase of the study as guides for developing items for the survey. These items were grouped around constructs that resembled the themes from the qualitative phase. Wherever suitable, she used language from the interviews and observations to develop the survey items, and minimize measurement error by using survey standards ^[21].

NSBE Study

The other authors (Julie, Shannon, Stacey and Stephanie) employed a qualitative grounded theory approach to explore the ways in which five African American engineering students developed and practiced engineering-related skills through participation in NSBE. Julie and Stephanie identified participants through the use of a database of over 275 potential participants created from a questionnaire/survey conducted with a national sample ^[22], and through snowball and chain sampling ^[23]. All five participants had completed their undergraduate studies at the time of their interview, with the years since graduation ranging from between 1 to 19. Three participants were male, and two were female. Julie and Stacey conducted semi-structured interviews with each participant in order to gather information about their transition to college, experiences as both undergraduates and graduates (if applicable), and involvement in non-curricular activities. Initial interviews, which were conducted via videoconferencing or phone, lasted approximately one hour. Julie and Stacey conducted a second interview with three of the participants to clarify experiences discussed in the first interview, gain a more in-depth understanding of their experiences and conduct member checking regarding emergent themes.

Stacey utilized the constant-comparative method to create emergent codes from the data collected ^[24]. This method entails the use of salient experiences to define new codes at which point each participant transcript was reviewed and analyzed using those new codes. For example, if during the analysis of the third transcript, Stacey created a new code, she would then return to the first two transcripts and review for evidence to support the new code. All of the codes and themes that were identified in the analysis came directly from—that is, was *grounded in*—the data. An additional researcher conducted a separate deductive analysis of the interview data using the *Engineer of 2020* traits as codes. This additional analysis revealed that participants described strong links between their NSBE participation and their development of specific traits.

Findings

Findings related to African American student and alumni participation in NSBE programs mirror several findings from the study of Latina/o students in SHPE programs. Specifically, results from the two studies share three common themes highlighting the benefits of involvement with non-curricular organizations. Participants describe NSBE and SHPE as (1) providing opportunities

for or explicitly emphasizing the development of professional and leadership skills; (2) being or having access to an engineering role model or mentor; and (3) creating a family-like support system.

As members of marginalized groups, students of color described experiencing an increased salience of their racial/ethnic identity, especially those participants attending PWIs. As such, many felt culturally isolated on their respective campuses. Participants spoke of an acute awareness that they were looked upon to constantly represent their race, as well as their profession (engineering), university, and the NSBE organization. As ethnic student organizations, NSBE and SHPE created spaces on PWI campuses where students of color felt welcomed, supported and encouraged, and where members were empowered through learning and engaging in professional practice.

Theme 1: Development of professional and leadership skills

Whereas recently proposed changes to the engineering ABET criteria may force an even further narrowing of the engineering curriculum and thus limit the development of the so-called “21st century skills” for all students^[25], organizations such as NSBE and SHPE continue to provide unique opportunities for engineering students of color to develop many of the professional skills outside of the classroom such as those described in the *Engineer 2020* vision. These two professional organizations provide unique opportunities for students to acquire skills and build knowledge that is not (or cannot be) taught in traditional engineering classrooms. African American and Latina/o engineering students develop skills such as communication, ethics, and time and resource management through interactions with the organization and other members. Furthermore, these organizations create environments where students of color are able to put their new knowledge into practice by engaging with professionals and by taking on leadership roles within the organizations.

Both studies found that the organizations provided students of color with formal and informal professional development and leadership training. Students holding leadership positions in NSBE or SHPE (i.e. those serving on committees, as chairpersons, and in executive positions) were able to specifically recall activities that led to their development as a professional and/or as a leader. The organizations hosted local, regional, and national workshops or retreats often composed of engineering professionals, staff, and more senior peers, (and too few faculty members) to give younger student leaders opportunities to receive advice, practice skills, and observe the behavior and attitudes of their professional counterparts.

Events and workshops hosted by these organizations created opportunities for students to network with and learn from engineering professionals. Participants who took advantage of these professional workshops gained invaluable insight into the hiring process; students were

challenged to think through how to craft strong resumes, and how to present themselves professionally during an interview and in the workplace. Although many of the workshops were explicitly designed to encourage students to engage in professional skill development, professional insight was not limited to the explicit training provided by the workshops. For example, many Latina/o participants spoke of learning how to present themselves as professionals by observing and interacting with their peers.

Participants spoke of organizational development training designed to help them learn the knowledge and skills related to the daily operation of the organization that would also translate into the workplace. Through their membership and experiences within NSBE and SHPE, African American and Latina/o engineering students develop skills such as planning and business management skills. Furthermore, the responsibilities they shouldered in their leadership positions frequently put them in control of situations that challenged them to maintain the high ethical standards they vowed to represent.

NSBE and SHPE exposed students to the many facets of being a leader, but more importantly participants explained that the organizations created opportunities for students to *practice and hone* these skills. NSBE and SHPE intentionally create opportunities for student leadership and rely heavily on student members to contribute to the planning and execution of events. The organizations often emphasize the importance of developing leadership skills, and thus offer structured leadership development workshops and retreats to their student leaders. In their leadership training, participants discussed what it meant to be a qualified leader in theory, but it was their actual interactions and experiences as student leaders that helped shape them into successful and respected engineering leaders.

For example, clear communication is essential to effective leadership. In industry, engineers often must be able to communicate their ideas or solutions with clients, they must communicate a project's goals and vision to collaborators, and they must communicate with peers on teams to accomplish goals. Their experiences as leaders in NSBE and SHPE helped the participants practice all of these communication dynamics. Furthermore, many participants described experiencing first-hand the consequences of poor communication when working within the organizations. For example, some participants spoke of miscommunications resulting in conflict between themselves and other members. Resolving and learning from conflict helped participants understand the value of effective communication.

In SHPE, students discussed how knowledge about leadership skills was passed down from executive board members to freshmen students. In some SHPE chapters, freshmen students formed their own junior executive board. The executive board members advised freshmen about the board and guided them in the organization of activities that would prepare them for an

executive board position. Through this interaction, students passed on knowledge about leadership.

Theme 2: Being or having access to an engineering role model

The two studies addressed relationships between the participants and individuals who inspired them. When participants spoke of having access to a role model, we created a code for serving as a role model or having a role model. We define a role model as a person(s) whom the participant observed and was inspired by without necessarily having any prior relationship or communication. For example, many participants explained that their faith in their own ability to become an engineer was strengthened after seeing someone excelling within an engineering program who “looked like them” or came from a similar background. Their role models inspired and motivated them to work harder. Additionally, many participants described increasing their involvement in NSBE/SHPE as a result of observing role models. As one participant said, “she is doing all these things— if she can do it I can do it.”

SHPE students described the influence role models had on their own engineering journeys and on their identification as engineers. Role models served to reinforce in students their ability to succeed in engineering. Additionally, having access to a role model led students to serve as role models for other students. Students articulated the need to “pay it forward” by being role models for other Latina/o students in engineering.

These relationships were not one sided; most of the participants spoke of feeling a moral responsibility to give back once they had progressed through their programs. The phrase “each one, teach one,” originated during the time of African slavery, was mentioned by a participant. Because slaves were denied the opportunity to read, whenever one did learn, they were encouraged and compelled to teach someone else in order to spread the knowledge. This communal spirit holds true today in the African American community and many participants noted they felt a sense of responsibility to give back to other students, in similar ways to those that came before them.

Most of the participants spoke of becoming a mentor to incoming students through a university-sponsored summer bridge program. Acting as a mentor allowed participants to pass the knowledge and insight they gained from their own experiences to the next generation of students. Paying it forward by being a mentor or role model not only satisfied the desire to give back, but it also helped participants develop as leaders. Furthermore, the alumni participants in the NSBE study continued to give back to NSBE even after they graduated. Participants spoke of guiding younger generations of NSBE members by returning as professionals to the leadership conferences to train new chapter leaders, run programs, and give advice.

Theme 3: Creating a family-like support system

Ethnic student organizations create unique environments for students of color attending PWI campuses to create family-like ties with others who share their cultural identity through spaces where these students feel accepted and supported.

Central to the SHPE organization is the emphasis on cultivating a SHPE *familia*. The organizational culture of this SHPE *familia* reflects relationships among the members where the participants felt that there was always someone there for them “no matter what,” where all members trusted one another, and where their “brothers” and “sisters” wanted them to succeed. Support for this *familia* culture is expressed throughout SHPE chapters and is reinforced by the national SHPE leadership. For example, at the 2014 national conference, attendees were encouraged to use the hash tag #SHPEfamilia when posting on social media.

Students’ sense of being part of a SHPE *familia* was reinforced through social and academic situations outside of attending SHPE events. Socially, students reported getting to know each other on a personal level. For example, students mentioned choosing to room together during the school year. Academically, students purposefully chose classes together and formed study groups.

Likewise, African American participants in NSBE also spoke of forming deep and meaningful relationships with other NSBE members and leaders that reflect the same dynamics of the SHPE *familia*. The NSBE participants described being able to “let their guard down” around NSBE peers as these peer members were “like them.” Participants also depicted other NSBE members as those they could trust, who supported and accepted them, and who again wished them to succeed.

The creation of the family-like bonds in NSBE often began with participation in their institution’s summer bridge program. These programs, typically hosted through the institution's Minority in Engineering Program, frequently included NSBE members acting as student leaders, which created opportunities for incoming students to meet peers with similar backgrounds. Bridge programs helped participants acclimate to their new college campus before the start of classes, form bonds with other African American students before the start of their first term, and become aware of campus resources. For many students, participation in a summer bridge program was their first introduction to the NSBE chapter on their campus and their initial connection to older NSBE members and staff. Being present on campus before of the rest of the

college students arrived for the fall term gave some of the NSBE participants the advantage of altering their dorm roommate assignments so they could live with other African American students. In the words of one participant, “we [NSBE members] lived together... studied together...did everything together.” The NSBE alumni participants described how these relationships progressed into life-long friendships lasting past their graduation, into graduate study and well into their professional and personal adult lives.

NSBE and SHPE participants formed meaningful, lasting friendships with fellow members, many of which were sustained throughout their entire college experience. Forming such significant bonds early in their college experience, especially before or during their first year, was essential in establishing the trust between the participants and the other organization members. This familial acceptance and support, in turn, created an environment where the participants felt comfortable to lower their guard, both academically and racially. This trust allowed participants to show academic vulnerability and share their struggles. Sharing these vulnerabilities helped participants become comfortable giving and receiving advice about success in both coursework and in sharing sensitive experiences resulting from the undergraduate experience as engineering majors. These academic struggles were in turn normalized for the participants who began to understand that such struggles in class were common for all students.

Implications for Practice

The aim of this paper is to put our research to use in enhancing current practice and policy in engineering education. By providing evidence of the positive influence of ethnic student organizations on Latina/o and African American engineering students’ academic and career development, it is our intent to provide a foundation to support participation in ethnic student organizations for other underrepresented students. The implications of this work reach beyond Latina/o and African American student populations, and are transferrable to other underrepresented groups.

Counter-Spaces

Our collective work reveals that NSBE and SHPE serve as social and academic counter-spaces throughout students’ engineering journeys. Created or co-created by students of color, social and academic counter-spaces on campus “serve as sites where deficit notions of people of color can be challenged and where a positive collegiate racial climate can be established and maintained”^[14]. In the field of engineering, where the students of color are acutely underrepresented, creating counter-spaces on campus facilitates cultural integration and student success. As academic counter-spaces, NSBE and SHPE serve as spaces where students feel acknowledged as competent and knowledgeable in the field of engineering. The counter-spaces validate students’ personal and academic journeys as real and important. In these spaces, students may feel more comfortable being academically vulnerable. As social counter-spaces, NSBE and SHPE serve as

spaces for students to share and validate their positive and negative experiences throughout their engineering journeys. As both academic and social counter-spaces, NSBE and SHPE served to affirm and support students' identification with engineering and as engineers. In other words, within these counter-spaces, being African American, Black, Hispanic, or Latina/o is synonymous with being an engineer. Through the existence of NSBE and SHPE as counter-spaces, students' identification as engineers, Black engineers, Latina/o engineers are affirmed. However, NSBE and SHPE are anchored to engineering primarily via the time, effort, and dedication of students.

Counter-spaces should not be the only place that African American and Latina/o students see their values reflected on campus. While counter-spaces are important for the persistence of students of color in higher education ^[14] and should continue to exist, *we assert that the values of counter-spaces should permeate all spaces within colleges of engineering*. Integrating values central to the counter-spaces is expected to lead to a cultural shift within engineering.

Calls to action

It is our goal to empower all members of the engineering education community to recognize, value, and support students of color, particularly on PWI campuses. Creating, supporting, and ensuring the livelihood of counter-spaces, such as those found in NSBE and SHPE, should not merely be the responsibility of students or dedicated faculty and staff whose positions serve underrepresented students, or the underrepresented students and faculty themselves. To that end, we put forth calls to action to university administrators, staff, and faculty to start the conversation and set the tone for future action, which we further elucidate below.

I. Administrators

We declare a call to action for university administrative leaders (provosts, deans, academic administrators, and department heads), who control the culture and climate of an institution or department. The power and ability to begin such conversations and set the tone for actions beyond these conversations makes university administrators an essential construct in adopting and permeating counter-spaces. Administrators can facilitate new, or promote existing, collaborations (1) between *institutional efforts* and ethnic student organizations, and (2) between *colleges of engineering* and ethnic student organizations. By promoting collaborations, administrators can cultivate welcoming and supportive environments on their campuses and to facilitate the permeation of counter-spaces throughout an institution. Relationships established between the administration and these traditionally underrepresented students will ensure a true reciprocal relationship, as these groups, now as true stakeholders, will see the success of the university equal to their own.

Administrators can facilitate counter-space permeation through promoting new or existing collaborations between institutional efforts and ethnic student organizations.

To support students through existing channels, universities must recognize and place value within these channels, and then make a concerted effort to establish meaningful partnerships with these organizations. Universities can take cues from organizations like NSBE and SHPE on learning how to connect with students of color, such as in establishing a rapport with ethnic student organizations to make their services more relevant to a multicultural student body.

Encouraging organizations or departments that plan university-wide events to partner with NSBE and SHPE creates opportunities for students to plan events and invite speakers that reflect their values. For example, extending invitations to both SHPE and NSBE to participate in university sponsored events, such as student orientation and career fairs will encourage “buy-in,” or support from a variety of organizations. Similarly, extending SHPE and NSBE invitations to speak about their organizations can indicate a genuine acceptance upon the part of the administration that such organizations are effective, competent and valued by the university.

Administrators can facilitate counter-space permeation through promoting new or existing collaborations between schools/colleges of engineering and ethnic student organizations.

An education in engineering holds implicit expectations and unwritten rules—there is no “engineering handbook” that institutions provide to new students. Some institutions have established engineering career centers that offer workshops and services to aid these students in gaining the skills and information to successfully acculturate into the current engineering norms and professional expectations. Others have university-wide career centers that offer similar mechanisms by which engineering students can gain professional proficiency. The workshops and professional development events held by NSBE and SHPE often parallel career development resources offered by institutions’ career centers and other university departments, yet many engineering students of color report gaining these skills and knowledge through ethnic student organizations such as NSBE and SHPE. The reason they provide is they feel more comfortable in settings with people that they know. A student’s first resource (e.g. Minority in Engineering Program, NSBE, SHPE) generally becomes their sole resource, and they continue to rely on the same program or organization throughout their educational career. Since students will go where they feel supported, the values of counter-spaces should permeate all spaces within colleges of engineering and PWIs. Thus institutional workshops and events must reflect the values of all students. Administrators might create innovative spaces to convey novel professional development skills that, although originally designed for students of color, *would benefit the entire engineering student body of a given institution.*

To create environments that respect and value students of color, administrators must incorporate structured training for faculty and staff to ensure such inclusivity of all people across the institution. Such training will indicate the university’s willingness to acknowledge and value

persons of color. It will empower faculty to challenge notions of the traditional demographic that has thus far characterized the actual look of the successful engineer, the skills that are valued, and the pathways by which skills can be gained. Assisting faculty and staff with learning how to value and support students different from themselves is a not new concept however. Indeed, many universities already offer training and education programs related to engaging with various communities on their respective campuses. For example, the incorporation of training to ensure that campuses are welcoming to students who identify as lesbian, gay, bisexual, transgender or queer (LGBTQ) is now a well-established concept. We will discuss specific methods below as to how faculty can support students of color and encourage administrators to consider the suggestions made by faculty.

Finally, administrators must be cognizant regarding who shoulders the responsibility of forging and sustaining the collaborations between student organizations and department-/university-sponsored initiatives; universities must provide adequate the resources and people required to continuously support students.

Although the cost associated with developing new student support programs, can be substantial, extending support to existing organizations such as NSBE and SHPE can help to limit the financial commitment required from an institution. Specifically, the inclusion of NSBE and SHPE, organizations which already exist on many campuses and which function independently of the university structure, would obviate the need to allocate new financial resources. Forging stronger connections between university offices and the leaders of ethnic student organizations can help institutional programs on PWI campuses become more beneficial for students of color. Institutions can seek input from and partner with ethnic student organizations to create more inclusive programs that understand and support the interests and needs of students of color. Although substantial financial commitments are not necessary, universities must still provide allocation of personnel resources (staff) and dedicated physical space for offices and events, particularly in lobbying for the creation of physical spaces on campus to house MEP offices and other areas where students may study and interact. Moreover, these spaces should be established in highly visible areas of campus to promote inclusivity, rather than being placed in nondescript areas on campus.

Additionally, the administration should also support the creation of permanent staff positions to create and maintain new, collaborative MEP/University efforts. University administrators should not assign responsibilities for creating and sustaining new collaborations to an existing MEP director. MEP directors carry a large amount of responsibility for supporting students of color on a day-to-day basis, often serving as the first point of contact when students are seeking resources. In order to expand the services offered to all students, MEP directors must have support from allies in both the administration and the engineering faculty. All members of the campus community play a role in creating a seamless experience for all students, and particularly students of color. In the process of creating inclusive spaces and programs, students of color

may continue to seek out ethnic-specific organizations for resources and support. However, the university should provide additional outlets for resources and support to ensure the success of its students.

II. Staff

Student affairs staff, academic affairs staff, MEP directors

Staff members across the university have a unique opportunity to support student organizations. SHPE and NSBE fall in the intersection between student affairs professionals and academic affairs staff members, such as MEP directors. Through intentional partnerships, student organization advisors should work with MEP directors to ensure that students in these groups have the tools to effectively lead and maintain their organizations. While resources are often provided from the national organizations for NSBE and SHPE, the on-campus resources are just as helpful. Student leaders should have the opportunity to be present at orientation events within their academic department as well as the larger campus organization fairs. By including these groups in annual programs and events, staff members can avoid the unintentional effects of tokenism that may arise if a special event is created targeting the population of students of color. Additionally, White students may benefit from knowing about and getting involved with NSBE and SHPE. These organizations are not exclusive in their membership and White students may take the opportunity to engage in peer mentoring and interacting with students of a different background to increase their cultural competence.

SHPE and NSBE are professional student organizations with the purpose of preparing students for careers in engineering and other STEM fields. Staff members in career services should partner with these groups to support the career development of their members. NSBE and SHPE members are already providing information related to professional dress, resume development, and networking to their members. Career services professionals could recruit student workers from these groups if they have student-led programs on these topics. Professionals could consult with these groups to learn about the needs of these student populations in order to develop new programs for students of color in a variety of disciplines at the university.

III. Faculty

We also issue a call to action for *all* engineering faculty—majority and underrepresented—to recognize the value of ethnic student organizations such as NSBE and SHPE to students' development and to explicitly support these organizations. Faculty can promote NSBE, SHPE and other ethnic student organizations, such as Black and Latino Greek-lettered organizations or minority in engineering programs, through simple actions such as inviting members to their classes to announce upcoming events. Faculty who include ethnic student organizations' announcements along with discipline-specific organizations help legitimize membership in all

organizations, and signal to all students (regardless of ethnicity) the equal importance of ethnic student organizations in students' professional development as compared to discipline-specific professional societies.

The majority of faculty who publicly support ethnic student organizations may discover opportunities to open dialogue with their students about diversity and inclusion. For example, the first author (Julie) found that including her travel plans to the NSBE National Convention in her class schedule for a large-enrollment undergraduate course sparked conversations with White students who questioned why she would attend the convention since she was not African American. As a result, she was able to discuss the significance of diversity in engineering with several White male students.

Adopting a concept from the LGBTQ community and women's advocacy groups, majority faculty can work with their campus's NSBE or SHPE chapter to become an "Ally" or "Advocate." White faculty need to be aware of the additional service tax that faculty of color experience, and make a conscious effort to be a faculty ally and advocate for ethnic student organizations so that the burden does not fall solely on underrepresented faculty. Professors can leverage their decision-making power at the university and in colleges of engineering through committee work and leadership by:

- Recognizing and verbalizing the legitimacy of student involvement and accomplishments in ethnic student organization when serving on committees for honors such as: student awards, scholarships, graduate school acceptance. This may require faculty to explain to their colleagues how these activities should hold equal weight as similar involvement in discipline-based professional societies.
- Joining one or more ethnic student professional organizations to better understand the values and keep current with organization's initiatives
- Encouraging colleges of engineering to have NSBE and SHPE alumni on their external advisory boards.
- Reaching out to ethnic student professional organizations alumni bases when serving on faculty search committees to help recruit a diverse pool of candidates.

Conclusion

We have presented the results from two separate research studies about the influence of ethnic student organizations in engineering on African American and Latina/o students. Across these two studies, we found that student members of the National Society of Black Engineers (NSBE) and the Society of Hispanic Professional Engineers (SHPE) developed their professional and leadership skills, served or had access to an engineering role model, and created a family-like support system. The results from these studies highlight the importance of NSBE and SHPE for students' engineering journeys. Based on the results from both studies, we posit that NSBE and

SHPE serve as counter-spaces for minoritized engineering students, especially at predominantly White institutions. NSBE and SHPE as counter-spaces serve to validate students' knowledge, engineering competency, and identity as engineers. These student organizations are an essential influence on students' professional and academic development. Because these student organizations are primarily managed, organized, and led locally by students, we pose a call to action to administrators, staff, and faculty in engineering colleges to support and learn from these student organizations.

A cultural shift in engineering is needed to serve all students in their engineering journeys. Our combined studies describe the importance of NSBE and SHPE as counter-spaces for the success of African American and Latina/o students. Our work also lays the foundation for other groups who hold similar underrepresented identities thus our findings and recommendations can translate across the institution. We propose that for a cultural shift to take place in engineering colleges, the values from ethnic, engineering student organizations should also be reflected outside of these counter-spaces.

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Appendix: Research Team's Reflexivity Statements

"The nature of qualitative research sets the researcher as the data collection instrument. It is reasonable to expect that the researcher's beliefs, political stance, cultural background (gender, race, class, socioeconomic status, educational background) are important variables that may affect the research process. Just as the participants' experiences are framed in social-cultural contexts, so too are those of the researcher." (p.2) ^[26]

From the first author [Julie]: As a white woman and a faculty member at a PWI, I have a genuine passion for transforming the culture of engineering education to more fully embrace diversity and increase inclusivity. I approach this work with keen awareness of my own White privilege, and a desire to use that privilege to help change engineering education norms. I do worry, however, that I lack the cultural authority necessary to work in the space of African American organizations. In conducting interviews for this research, I continually debriefed with Stephanie and Stacey to understand the structural and cultural elements of NSBE, confer about the wording of interview questions, and discuss of the possibility that participants would be less

than forthcoming in interviews because of my privilege. I also memoed about my privilege and shared the resulting document with the research team.

From the second author [Renata]: My own personal and academic pathways have influenced my scholarly interest in understanding how students of color in engineering are successful. As a Latina and former engineering student, I was involved in the Society of Hispanic Professional Engineers, which was necessary to my own success. I have been a member of SHPE since 2003 and many of the stories recounted by the students whom I interviewed echoed with my own academic experiences in engineering. My personal and scholarly interest in engineering development identity deepened with my study of how Latina/o students developed engineering identities. I realized that the conventional literature based conceptualization of the development of engineering identity was often generalized to an “engineering student,” and not differentiated by the nuance of sophisticated social identities. Based on my personal experiences as a SHPE member, I thought the conceptualization of engineering identity development failed to fully reflect my experience within this organization. As a Latina member of SHPE, as an undergraduate, I quickly developed a rapport with my interview subjects. My knowledge of how SHPE worked, from the student perspective, helped with the flow of the interview and the types of follow-up questions I was able to ask students. Some students felt comfortable speaking in Spanish during the interviews knowing that I would be able to understand them. As part of my data collection and analysis, I also began to reflect as to how my own experiences were affected and intersect with the students’ experiences and the data they were reporting. After each interview I worked on a post-interview reflection, and during the interview analysis, I wrote memos for each of the emergent codes to reflect on my own experiences as related to the codes [27]. Finally, I engaged in peer debriefing with at least one colleague per week throughout the interview process.

From the third author [Shannon]: I am a White woman pursuing a doctoral degree in engineering and science education. I have been trained as both a physicist and as an education researcher; as such, I identify as a woman in a STEM field, as an education researcher, as a physicist, and as an educator. My struggles with my own undergraduate science education, and my experiences as a woman in a traditionally male-dominated field have given me a unique perspective on and passion for promoting equity and diversity within science and engineering education. However, as a White woman investigating the experiences of African American and Latina/o participants, I remain ever mindful of how my background may limit my ability to fully comprehend the experiences of our participants. Thus, I worked very closely with Stacey throughout the data analysis process. Specifically, I relied on frequent peer debriefing with Julie and Stacey to verify my interpretations of the data and to deepen my understanding of each participant’s cultural and psychological perspective.

From the fourth author [Stacey]: I am a Black woman pursuing a doctorate in educational leadership, with a background in student organization advising. I spent six years working with housing and advising fraternities and sororities. While I do not have a background in engineering, I hold degrees from and have worked professionally at predominantly White institutions, the experiences of which as a woman of color at PWIs were mirrored in the data collected. I too used the memo writing process to identify and separate my experiences from the participants' experience, a process which helped me define and present the concept of the Black student experience as a context for the data collected. Throughout the research process, I wrote memos about my personal experiences as a member of a BGO, in order to name those experiences and distinguish them from the data analysis. With memo-writing and peer debriefing, I subsequently crafted codes from the data which I used to interpret that data that led to our findings.

From the fifth author [Stephanie]: I have a keen understanding of and familiarity with the process of educating all students, particularly those from underrepresented populations. Although I attended a predominantly White institution as an undergraduate and was a recipient of the services my local MEP Office provided, I ultimately graduated from an HBCU. As a student, I was elected to the national executive board of NSBE, of which I am a lifetime member, and I presently serve on the National Advisory Board. I am also a lifetime member of a BGO, and have remained quite involved their activities over the last 20 years after graduation. I have also served as Advisory/Executive Board member for NSBE, WEPAN, and the National Consortium Graduate Degrees for Minorities in Engineering and Science (GEM), all of which are committed to improving diversity in STEM. I expect that my involvement in this project will provide the context necessary to ensure the greatest accuracy of the data interpreted.

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